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Qualification Guidelines for Personal Computer-Based Aviation Training Devices: Instrument Training

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16. Abstract

This is a report of the analytical development of qualification guidelines for personal computer-based aviation training devices (PCATDs) for use in instrument flight training. The report includes a task analysis of instrument flight tasks, along with baseline and task-specific guidelines that were developed as a result of the analysis. In addition a PCATD qualification tool is presented in the appendix for use in approving a Part 141 flight school curriculum that incorporates a PCATD for use as a ground training aid. The purpose of this paper is to provide the reader with an understanding of the process and reasoning behind the development of the PCATD qualification guidelines.

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QUALIFICATION GUIDELINES FOR PERSONAL COMPUTER-BASED AVIATION TRAINING DEVICES: INSTRUMENT RATING

As part of the development of qualification guidelines for a personal computer-based aviation training device (PCATD), a task analysis of instrument flight tasks has been completed and is reported in this paper. In addition to the task analysis, task-specific qualification guidelines have been developed for each of the flight tasks listed. The purpose of this paper is to present the analysis and to provide the reader with an understanding of the process and reasoning used to conduct the analysis. As with any task analysis, its utility is determined primarily by the purpose for which it was accomplished, however, the analysis, perhaps in some modified form, may be useful for other purposes within the aviation training community.

Guideline Use

The qualification guidelines, when used in combination with a soon to be released Advisory Circular, will enable a pilot school to gain approval for the use of a PCATD in an integrated ground and flight training curriculum under Part 141 of the Federal Aviation Regulations (FAR). Figure 1 illustrates how the curriculum approval process would occur. Box 1 denotes that the curriculum approval process would be initiated by application of a flight training facility aspiring for approval as a Part 141 training school.

Boxes 2 and 3 show that the Flight Standards District Office (FSDO) inspector would evaluate the Part 141 curriculum relative to the use of PCATDs and would then perform an analysis of the PCATD being used in the curriculum using the PCATD Qualification Tool (PQT). Use of the PQT involves a five-step process: 1) Obtain PCATD descriptive information; 2) Compare baseline guidelines with PCATD specifications; 3) Identify flight tasks to be trained using the PCATD; 4) Assess candidate PCATD on individual flight tasks; 5) Approve or disapprove the curriculum. Details of this five step process are given in the appendix. FAR Part 141.53 requires FAA approval of training courses, or amendments to train-

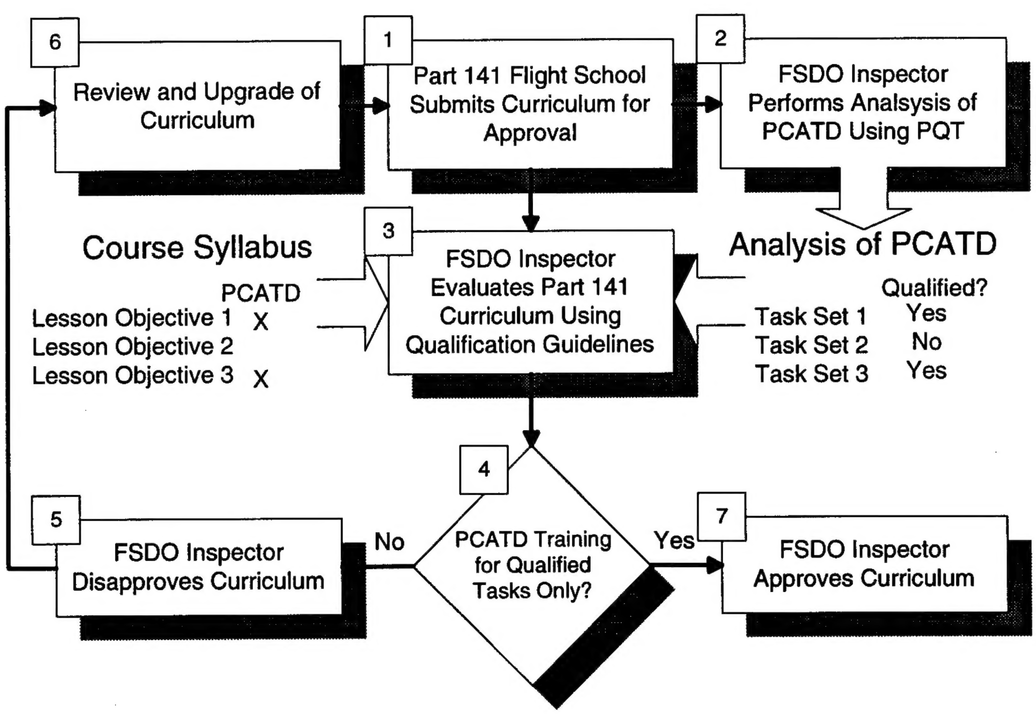

Figure 1. Approval of a Part 141 curriculum using the PCATD qualification guidelines.

ing courses, through the local FSDO. Part 141.55 specifies the information that must be submitted to the Federal Aviation Administration (FAA) for this purpose. A FSDO inspector, whose task it is to approve a Part 141 curriculum, must ensure that the PCATD to be used in the curriculum will be used to train only those lesson objectives (tasks) for which it has been approved.

Box 4 shows that the FSDO inspector, after comparing the course curriculum with the results of the evaluation of the PCATD, will decide if the PCATD is being used to train only those tasks that it is suited to train. If it is not, the inspector will disapprove the curriculum with an explanation of how the PCATD is being inappropriately applied (Box 5). The school can then review and upgrade the curriculum and begin the approval process again (Box 6). If the training device is being used properly within the curriculum, the FSDO inspector will approve the curriculum, and the process is complete (Box 7).

It is not intended that users of the guidelines will be required to search through the entire task analysis. The analysis is provided so that the process used to generate any particular guideline can be understood. Results of the analysis are summarized at the end of this document.

Developing the Flight Task Data Base

The first step in the analysis involved the development of a flight task data base for instrument flight tasks. The information came from two main sources. The first source was the Practical Test Standards for the Instrument Rating (FAA-S-8081-4A, 1989). These standards provided a listing of tasks required to receive an instrument rating, along with minimum performance criteria for each task. However, the Practical Test Standards only list those tasks that would be required as part of the certification practical test. They do not list all of the tasks that would commonly be taught during a course of training for the instrument rating. The second source of information was syllabi from selected Part 141 flight schools. The resulting data base was reviewed and confirmed by certified instrument flight instructors (CFIIs) as well as Flight Standards District Office (FSDO) inspectors. Table 1 presents the flight task data base for instrument rating used in the task analysis. While it may not include every task taught during a normal intrument flying course, an attempt was made to include all of those tasks that would be trainable using a suitably equipped PCATD.

Analysis of the Flight Task Data Base

Data for this analysis came from several sources including: interviews with flight instructors from certificated pilot schools; Practical Test Standards; commercially developed pilot maneuvers guide, the Instrument Flying Handbook (AC 61-27C), and the Airmen's Information Manual (ASA-94-AIM). The analysis of each task is divided into four sections. The first section is a statement of the learning objectives for that task. The learning objectives for each task were identified by an analysis of task objectives and criteria, task nomenclature, particular controls and displays utilized during the performance of that task, environmental information used in the task, and movements and procedures required to complete each task. The summarization of learning objectives differs for various tasks, depending on the type of task, the complexity of the task, and the degree to which the task relies on previously learned objectives. Some task learning objectives are stated in the form of a summary paragraph, while others are broken down in the form of subtasks and task elements. *The learning objectives of each task were analyzed to the extent necessary to make a clear statement of the inputs and outputs required to perform that task.* These inputs and outputs comprise the second section of the task analysis.

The second section of the task analysis consists of a listing of the user inputs and outputs required to perform that task. The inputs and outputs are those data that are required by the user (and so must be provided to the user by either the PCATD or from some other source) and actions that must be performed by the user to accomplish a particular task. Note that an input to the user is an output from somewhere else (primarily the PCATD), so potential confusion can arise if it is not kept clear who is receiving the inputs and giving the outputs. In this analysis, the user is the focal point since the user is the

Table 1. Flight Task Listing for Instrument Rating

1.0 Ground Phase
- 1.1 Obtaining weather information
- 1.2 Cross-country flight planning
- 1.3 Aircraft systems related to IFR operations
- 1.4 Aircraft flight instruments and navigation equipment
- 1.5 Instrument cockpit check

2.0 Flight by Reference to Instruments
- 2.1 Straight-and-level flight
- 2.2 Change of airspeed
- 2.3 Constant airspeed climbs to altitude
- 2.4 Constant rate climbs to altitude
- 2.5 Constant airspeed descents to altitude
- 2.6 Constant rate descents to altitude
- 2.7 Precision descent
- 2.8 Level turns
- 2.9 Standard rate turns
- 2.10 Short turns
- 2.11 Climbing turns
- 2.12 Descending turns
- 2.13 Steep turns

3.0 Abnormal and Emergency Procedures
- 3.1 Unusual attitudes
- 3.2 Timed turns
- 3.3 Compass turns
- 3.4 Partial panel maneuvers
- 3.5 Loss of communications
- 3.6 Instrument failure
- 3.7 Systems failure
- 3.8 Turbulence
- 3.9 Engine failure
- 3.10 Lost procedures

4.0 Radio Navigation Procedures
- 4.1 VOR Navigation
- 4.2 NDB Navigation
- 4.3 Localizer & ILS Navigation
- 4.4 DME arc
- 4.5 VOR holding pattern
- 4.6 NDB holding pattern
- 4.7 Localizer holding pattern
- 4.8 DME holding pattern
- 4.9 Intersection holding pattern

5.0 Instrument Approaches
- 5.1 VOR/VORTAC instrument approach procedure
- 5.2 NDB instrument approach procedure
- 5.3 ILS/MLS instrument approach procedure
- 5.4 ILS back course approach procedure
- 5.5 RNAV approach procedure
- 5.6 Missed approach procedure

6.0 Communications Procedures
- 6.1 Air Traffic Control clearances
- 6.2 Departure clearances
- 6.3 Enroute clearances
- 6.4 Arrival clearances

7.0 Cross-country Procedures
- 7.1 Departure procedures
- 7.2 Enroute procedures
- 7.3 Arrival procedures

one learning. So for any task, it is important to specify what inputs the user requires and what outputs the user must give to perform the specific task.

The third section of the task analysis is a statement of the training considerations that are relevant to that task. These training considerations concern how training on that task is accomplished. These considerations include items such as the initial conditions of the task (i.e., the state of the simulation at the beginning of performance of a task), how certain task parameters should vary during practice on the task, and any special training requirements that are peculiar to that task.These considerations do not determine whether or not training transfer occurs for that task, but they will affect the quality of the training received by correctly performing the task.

Developing a Prototype Set of Qualification Guidelines

The fourth section of each task analysis is a translation of the data in the previous three sections into a set of training device qualification guidelines for that task. The guidelines are divided into four categories: 1) controls, 2) displays, 3) flight dynamics, and 4) instructional management. The first three categories deal with the simulation of flight and the aircraft cockpit. Instructional management characteristics of the device manage the nature, and kind of training, that can be accomplished using the device. The development of guidelines was done with two assumptions in mind. The first assumption is that the aircraft simulated is a single engine, fixed gear, basic training aircraft with a fixed-pitch propellor. The second assumption is that the PCATD will be used as part of an organized flight training curriculum, and all practice on the device will be accomplished under supervision of a qualified flight instructor.

Baseline Qualification Guidelines

To simplify the process of specifying the qualification guidelines for each task, a baseline set of qualification guidelines has been identified on which to build. This baseline set of guidelines will be required for any PCATD used in an integrated ground and flight training program. Task specific guidelines given as a result of the task analysis will note only those qualification guidelines that are in addition to those given in the baseline.

This section includes a general summary of the baseline PCATD qualification guidelines discussed above. The guidelines specify general device characteristics that any PC-based simulation device should possess, regardless of the type of training for which it is used. These guidelines are divided into four categories: (1) controls, (2) displays, (3) flight dynamics, and (4) instructional management.

Controls

Controls used in the PC-based simulation device can be of two types: physical and virtual. Both types of controls should be recognizable solely from their appearance as to their function and how they can be manipulated. This requirement eliminates the use of a keyboard to control the simulated aircraft (although a keyboard may still be used in controlling aspects of the simulation, such as setting initial aircraft state, location, wind, etc.). A physical control is an actual physical object that, when manipulated, provides input to the flight simulation. A virtual control is defined here as a realistic graphical representation of a physical control, displayed on the computer screen, that can be unambiguously manipulated through the use of a computer input device. An example of a virtual control is a realistic-looking flaps switch that is displayed on the computer screen and manipulated through any computer cursor-control device, such as a mouse, or more directly with touch-screen technology. The cursor is positioned on the flaps switch and "pressed" by an appropriate action with the input device. A virtual control provides a sense of direct manipulation of a control without requiring the presence of external hardware. The baseline qualification guidelines for controls are as follows:

1. A physical, self-centering, displacement yoke or control stick that allows continuous adjustment to rate of change of pitch and bank.
2. Physical, self-centering rudder pedals that allow continuous adjustment to rate of change of yaw.
3. A physical throttle control that allows continuous movement from idle to full power settings.

4. Physical or virtual controls for flaps, pitch trim, communication and navigation radios, VOR, ADF, and a clock or timer. It is not necessary that the pitch trim control relieve control pressure as it does in an actual aircraft. However, the pitch trim control might allow the simulated aircraft to be stabilized at any particular pitch attitude with the yoke or control stick in the neutral position.
5. Time from control input to recognizable system response (transport delay) should be 300 milliseconds or less.

Displays

6. Displays represented should include an altimeter, heading indicator, airspeed indicator, vertical speed indicator, turn and bank coordinator, attitude indicator, tachometer, flaps setting, pitch trim indication, communication and navigation radios, VOR (with ILS indicator), with an aural, morse code identification feature, ADF, with an aural, morse code identification feature, clock or timer, and a magnetic compass.
7. Relative layout of the primary displays must correspond to the standard "T" configuration with (a) airspeed, (b) attitude and (c) altimeter forming the "cap" with (d) the heading indicator, located in the "stem" below the attitude indicator.
8. Size, shape, and information content of displays should closely resemble those found commonly in a single-engine, fixed-pitch propeller, basic training aircraft with a fixed landing gear.
9. Display update should be 10Hz or faster and be free of distracting rastering, stepping, aliasing, or quantization.
10. The smallest display changes should be discriminable from pilot's normal operating position and correspond to the following information:

Airspeed indicator --------	Change of 5mph or less in airspeed
Attitude indicator ----------	Change of 2° or less pitch or bank
Altimeter --------------------	Change of 10ft. or less in altitude
Turn and bank ------------	Change of 1/4 standard rate turn or less
Heading indicator ---------	Change of 2° or less in heading
VSI ---------------------------	Change of 100 ft. per min. or less in vertical speed
Tachometer ----------------	Change of 25 RPM or less in engine RPM
VOR/ILS --------------------	Change of 1/2 dot or less in bearing deviation
ADF --------------------------	Change of 2° or less in relative bearing
Clock or timer -------------	Change of 1 second or less

11. Displays should reflect dynamic behavior of an actual aircraft display (e.g., VSI reading of -500 fpm is reflected by a corresponding movement in altimeter, an increase in throttle is reflected by an immediate increase in RPM indicator, etc.).

Flight Dynamics

12. Flight dynamics of the simulated aircraft should be comparable in performance and handling with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
13. Aircraft performance parameters (maximum speed, cruise speed, stall speed, maximum climb rate) should be comparable to a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
14. Aircraft vertical lift component should change as a function of bank, comparable to a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
15. Changes in flap setting should be accompanied by appropriate changes in flight dynamics.

Instructional Management

16. User should be able to pause the system at any point for the purpose of receiving instruction regarding the task.
17. For the purpose of beginning a training session with the aircraft already in the air and ready for the performance of a particular maneuver, the user should be able to manipulate the following system parameters independently of the simulation:
    Geographic aircraft location (location within the available digitized space)
    Aircraft heading
    Aircraft airspeed
    Aircraft altitude
    Engine RPM
18. The system should be capable of recording both a horizontal and vertical track of aircraft position during the performance of a task for later playback and review.

Tables 2 through 8 present the complete task analysis for instrument flight tasks. A separate table is given for each of the seven task sets identified in Table 1. Following the tables is a summary that provides a listing of all of the guidelines and provides a cross-reference between each task and the guidelines.

Table 2. Instrument Flying Task Analysis: Ground Phase

Authorization: Instrument Rating
Task Set: 1.0 Ground Phase
Task: 1.1 Obtaining weather information

Learning Objectives

The learning objective of this task is to acquire the ability to obtain, read, and analyze aviation weather information including the following: 1) weather reports and forecasts; 2) pilot and radar reports; 3) surface analysis charts; 4) radar summary charts; 5) significant weather prognostics; 6) winds and temperatures aloft; 7) freezing level charts; 8) stability charts; 9) severe weather outlook charts; 10) constant pressure charts; 11) constant pressure prognostics; 12) tables and conversion graphs; 13) SIGMETs and AIRMETs; and 14) ATIS reports. A further learning objective is to obtain the ability to analyze the the assembled weather information pertaining to the proposed route of flight and destination airport, and determine whether an alternate airport is required, and, if required, whether the selected alternate airport meets the regulatory requirements.

Input Requirements:

- weather information in all formats listed above
- navigational chart information containing proposed route of flight, destination airport and at least one alternate airport

Output Requirements:

- demonstration of understanding of weather information in all formats listed above
- analysis of assembled weather information pertaining to a proposed route of flight and destination airport
- determination of whether an alternate airport is required, and, if required, whether the selected alternate meets the regulatory requirement

Training Considerations

The demonstration of an understanding of weather information can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should be able to provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
PCATD can display all of the various forms of weather-related information, as well as a navigational chart and information related to the airports displayed on that chart.

Instructional Management:
PCATD can train knowledge of weather through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of weather-related knowledge that are lacking. PCATD can train ability to analyze a specific route of flight and destination in relation to weather information through the use of multiple choice questions, fill-in-the-blanks, etc.

Authorization: Instrument Rating
Task Set: 1.0 Ground Phase
Task: 1.2 Cross-country flight planning

Learning Objectives

1.2.1 Perform preliminary weather check

1.2.2 Select tentative route(s) to destination airports and alternate(s)
- 1.2.2.1 Select a proposed altitude for each route
- 1.2.2.2 Select route segments and checkpoints
- 1.2.2.3 Correct for true and magnetic course readings
- 1.2.2.4 Compute distances for each route segment
- 1.2.2.5 Record communication and navigation frequencies to be used during the flight

1.2.3 Gather current instrument approach procedure charts for destination and alternate airports

1.2.4 Gather current information on facilities and procedures related to flight
- 1.2.4.1 Check Airport/Facility Directory for airport conditions regarding lighting, obstructions, and other notations under "Airport Remarks." Also, check services at destination airport and alternate(s)
- 1.2.4.2 Check Notices to Airmen (Class II, FDC NOTAMS)

1.2.5 Contact Flight Service Station (FSS) in person or by telephone for preflight briefing

1.2.6 Complete flight log
- 1.2.6.1 Compute true airspeed, wind data, and groundspeed
- 1.2.6.2 Compute estimated time enroute
- 1.2.6.3 Compute estimated time between check points
- 1.2.6.4 Compute fuel required

1.2.7 Compute weight and balance

1.2.8 Complete flight plan (FAA Form 7233-1) and file with FSS at least 30 minutes before estimated departure time

Input Requirements:

- weather information in all formats listed under Task 1.1
- navigational chart information containing proposed route of flight, destination airport and at least one alternate airport
- instrument approach procedure charts for destination and alternate airports
- facilities information from Airport/Facility Directory and NOTAMS

Output Requirements:

- selected routes to destination airports and alternate(s)
- analysis of assembled weather information pertaining to a proposed route of flight and destination airport
- determination of whether an alternate airport is required, and, if required, whether the selected alternate meets the regulatory requirement
- flight log information
- weight and balance information
- flight plan

Training Considerations

Much of the information required to complete this task can be provided independently of the computer. This includes an Airport/Facility Directory, NOTAMS, and instrument approach procedure charts. The PCATD should ensure the trainee understands the use of this information by controlling the completion of a flight log and flight plan and providing feedback on errors in the computation of various flight parameters (distances, headings, airspeeds, etc.).

Device Qualification Guidelines

Displays:

PCATD can display all of the various forms of weather-related information, as well as a navigational chart and information related to the airports displayed on that chart

PCATD can display a flight log and a flight plan

Instructional Management:

PCATD provides feedback regarding the selection of route segments and checkpoints, the computation of headings, distances, airspeed, wind data, groundspeed, time enroute, estimated time between check points, fuel required, weight and balance, and the correct procedure for completing and filing a flight plan.

Authorization: Instrument Rating
Task Set: 1.0 Ground Phase
Task: 1.3 Aircraft systems related to IFR operations

Learning Objectives

The learning objective of this task is to acquire adequate knowledge of aircraft anti-icing/deicing systems and their operating characteristics to include: 1) airframe; 2) propellor/intake; 3) fuel system; and 4) pitot-static.

Input Requirements:

- information about aircraft anti-icing/deicing systems and their operating characteristics

Output Requirements:

- demonstration of understanding of aircraft anti-icing/deicing system(s) and their operating characteristics

Training Considerations

The demonstration of an understanding of anti-icing/deicing systems and their operating characteristics can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should be able to provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Instructional Management:

PCATD trains knowledge of anti-icing/deicing systems and their operating characteristics through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking for all of the following systems: 1) airframe; 2) propellor/intake; 3) fuel system; and 4) pitot-static.

Authorization: Instrument Rating
Task Set: 1.0 Ground Phase
Task: 1.4 Flight instruments and navigation equipment

Learning Objectives

The learning objective of this task is to acquire adequate knowledge of aircraft flight instrument systems and their operating characteristics to include: 1) pitot-static; 2) altimeter; 3) airspeed indicator; 4) vertical speed indicator; 5) attitude indicator; 6) horizontal situation indicator; 7) magnetic compass; 8) turn-and-slip indicator/turn coordinator; and 9) heading indicator, and to acquire adequate knowledge of aircraft navigation systems and their operating methods to include: 1) VHF omnirange (VOR); 2) distance measuring equipment (DME); 3) instrument landing system (ILS)/microwave landing system (MLS); 4) marker beacon receiver/ indicators; 5) transponder/altitude encoding; and 6) automatic direction finding (ADF).

Input Requirements:

- information of aircraft flight instrument systems and their operating characteristics
- information of aircraft navigation systems and their operating methods

Output Requirements:

- demonstration of understanding of aircraft flight instrument systems and their operating characteristics
- demonstration of understanding of aircraft navigation systems and their operating methods

Training Considerations

The demonstration of an understanding of flight instrument systems and their operating characteristics and navigation systems and their operating methods can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should be able to provide feedback to the student regarding areas in need of review for each of the flight instrument systems listed above.

Device Qualification Guidelines

Instructional Management:
PCATD trains knowledge of flight instrument systems and their operating characteristics and navigation systems and their operating methods through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Instrument Rating
Task Set: 1.0 Ground Phase
Task: 1.5 Instrument cockpit check

Learning Objectives

1.5.1 Perform pre-engine-start checks
- 1.5.1.1 Note presence of appropriate handbooks, enroute charts, approach charts, computer, and flight log
- 1.5.1.2 Confirm radio equipment switches are set to off position
- 1.5.1.3 Confirm suction gauge has proper indication
- 1.5.1.4 Confirm pitot cover is removed
- 1.5.1.5 Confirm airspeed indicator has proper reading
- 1.5.1.6 Confirm heading indicator is uncaged (if applicable)
- 1.5.1.7 Confirm turn coordinator miniature aircraft is level and ball is approximately centered (while on level terrain)
- 1.5.1.8 Confirm vertical-speed indicator has zero indication
- 1.5.1.9 Confirm magnetic compass is full of fluid
- 1.5.1.10 Confirm clock is functional and set to proper time or timer is functional
- 1.5.1.11 Confirm engine instruments have proper markings and readings

1.5.2 Start engine

1.5.3 Perform post-engine-start checks
- 1.5.3.1 Confirm suction gauge has proper indication and, if gyros are electrically driven, check generators and inverters for proper operation
- 1.5.3.2 Check that pitot head has heat
- 1.5.3.3 Check magnetic compass card moves freely and is accurate
- 1.5.3.4 Compare heading indicator reading to magnetic compass reading after allowing 5 minutes after engine start for gyro rotor to attain normal operating speed
- 1.5.3.5 Check attitude indicator has proper indications after allowing 5 minutes after engine start for gyro rotor to attain normal operating speed and adjust miniature aircraft to the horizon bar
- 1.5.3.6 Note any variation between known field elevation and altimeter indication while altimeter is set to current reported altimeter setting

1.5.3.5 Check attitude indicator has proper indications after allowing 5 minutes after engine start for gyro rotor to attain normal operating speed and adjust miniature aircraft to the horizon bar
1.5.3.6 Note any variation between known field elevation and altimeter indication while altimeter is set to current reported altimeter setting
1.5.3.7 Check miniature aircraft and ball of turn coordinator has proper indications during taxi turns and straight taxiing
1.5.3.8 Check vertical-speed indicator for zero reading
1.5.3.9 Check carburetor heat for proper operation and return to cold position
1.5.3.10 Check engine instruments for proper readings
1.5.3.11 Check radio equipment for proper operation and set as desired

Input Requirements:

- radio power status
- suction gauge status
- pitot cover status
- airspeed
- turn coordinator status
- vertical-speed
- engine instrument readings
- heading
- attitude
- altitude
- carburetor heat status

Output Requirements:

- radio power
- heading indicator adjustment
- altimeter setting
- carburetor heat setting
- radio tuning

Training Considerations

Since some of the tasks require going outside of the cockpit (e.g., checking pitot tube), they will be ignored in the specification of device qualification guidelines. Engine start procedures are not covered since they are a part of private pilot training. Activities during taxi are ignored in order to avoid excessive control and flight dynamics requirements.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical or virtual control for altimeter setting and carburetor heat

Displays:

PCATD should have the following displays

- engine instruments
- suction gauge

Table 3. Instrument Flying Task Analysis: Flight by Reference to Instruments

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.1 Straight-and-level flight

Learning Objectives

2.1.1 Scan each primary flight instrument in the order and at a sampling rate determined by mission segment

2.1.2 Maintain altitude within 100ft.
2.1.2.1 Monitor attitude indicator, altimeter, vertical speed indicator, and airspeed indicator
2.1.2.2 Use half-bar-width correction in attitude indicator for altitude errors of less than 100 ft.
2.1.2.3 Use full-bar-width correction in attitude indicator for altitude errors of 100 ft. or more
2.1.2.4 Make an attitude change to correct altitude errors that will result in a vertical speed approximately double the error in altitude but never exceeding optimum rate of climb or descent for a given airspeed and configuration
2.1.2.5 Recall lag characteristics of vertical speed indicator when monitoring instrument

2.1.3 Maintain heading within 10°
2.1.3.1 Monitor attitude indicator, heading indicator, and turn coordinator
2.1.3.2 Make correction for heading errors by using an angle of bank no greater than number of degrees to be turned and never greater than that required for a standard-rate turn

2.1.4 Maintain airspeed within 10kts.
2.1.4.1 Monitor airspeed indicator, attitude indicator, altimeter, and engine power output indicator (manifold pressure gauge or tachometer)
2.1.4.2 Determine need for a change in pitch and/or power based on relationship between altitude and airspeed
2.1.4.3 Make initial power changes greater than desired setting to accelerate rate of airspeed change except for small speed changes
2.1.4.4 Apply aileron and rudder pressures when increasing power to counteract left yaw and roll tendencies

2.1.5 Make small adjustments in controls with light control pressures to correct for deviations in attitude.
2.1.5.1 Make adjustments in controls to stop movement of instrument indications
2.1.5.2 Make adjustments in controls to return to desired altitude, heading or airspeed

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.2 Change of airspeed

Learning Objectives

2.2.1 Maintain straight-and-level flight

2.2.2 Transition from cruise airspeed to slow flight
- 2.2.2.1 Set approximate pitch and power for required change in airspeed in a smooth and timely manner
- 2.2.2.2 Set flaps to stage 1 (depending on training goal)
- 2.2.2.3 Make proper use of trim control
- 2.2.2.4 Scan continuously without fixation or omission
- 2.2.2.5 Make small adjustments in controls to correct for deviations in airspeed and heading

2.2.3 Transition from slow flight to cruise airspeed
- 2.2.3.1 Set approximate pitch and power for required change in airspeed in a smooth and timely manner
- 2.2.3.2 Set flaps to full up
- 2.2.3.3 Make proper use of trim control
- 2.2.3.4 Scan continuously without fixation or omission
- 2.2.3.5 Make small adjustments in controls to correct for deviations in airspeed and heading

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting
- flaps setting

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft..

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.3 Constant airspeed climb to altitude

Learning Objectives

2.3.1 Maintain straight-and-level flight

2.3.2 Transition from staight-and-level flight to a constant airspeed climb configuration
- 2.3.2.1 Set full power and approximate pitch for required climb speed in a smooth and timely manner
- 2.3.2.2 Make proper use of trim control
- 2.3.2.3 Scan continuously without fixation or omission
- 2.3.2.4 Make small adjustments in controls to correct for deviations in climb speed and heading

2.3.3 Transition from a constant airspeed climb to straight-and-level flight at desired altitude
- 2.3.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 2.3.3.2 Set approximate pitch and power for straight-and-level flight
- 2.3.3.3 Make proper use of trim control
- 2.3.3.4 Scan continuously without fixation or omission
- 2.3.3.5 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.4 Constant rate climb to altitude

Learning Objectives

2.4.1 Maintain straight-and-level flight

2.4.2 Transition from staight-and-level flight to a constant rate climb configuration
- 2.3.2.1 Set full power and approximate pitch for required climb rate in a smooth and timely manner
- 2.4.2.2 Make proper use of trim control
- 2.4.2.3 Scan continuously without fixation or omission
- 2.4.2.4 Make small adjustments in controls to correct for deviations in climb rate and heading

2.4.3 Transition from a constant rate climb to straight-and-level flight at desired altitude
- 2.4.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 2.4.3.2 Set approximate pitch and power for straight-and-level flight
- 2.4.3.3 Make proper use of trim control
- 2.4.3.4 Scan continuously without fixation or omission
- 2.4.3.5 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.5 Constant airspeed descent to altitude

Learning Objectives

2.5.1 Maintain straight-and-level flight

2.5.2 Transition from staight-and-level flight to a constant airspeed descent configuration
- 2.5.2.1 Set approximate pitch and power for required descent speed in a smooth and timely manner
- 2.5.2.2 Set flaps to stage 1 (depending on training goal)
- 2.5.2.3 Make proper use of trim control
- 2.5.2.4 Scan continuously without fixation or omission
- 2.5.2.5 Make small adjustments in controls to correct for deviations in descent speed and heading

2.5.3 Transition from a constant airspeed descent to straight-and-level flight at desired altitude
- 2.5.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 2.5.3.2 Set flaps to full up.
- 2.5.3.3 Set approximate pitch and power for straight-and-level flight
- 2.5.3.4 Make proper use of trim control
- 2.5.3.5 Scan continuously without fixation or omission
- 2.5.3.6 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting
- flaps setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.6 Constant rate descent to an altitude

Learning Objectives

2.6.1 Maintain straight-and-level flight

2.6.2 Transition from staight-and-level flight to a constant rate descent configuration
- 2.6.2.1 Set approximate pitch and power for required descent rate in a smooth and timely manner
- 2.6.2.2 Make proper use of trim control
- 2.6.2.3 Scan continuously without fixation or omission
- 2.6.2.4 Make small adjustments in controls to correct for deviations in descent rate and heading

2.6.3 Transition from a constant rate descent to straight-and-level flight at desired altitude
- 2.6.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 2.6.3.2 Set approximate pitch and power for straight-and-level flight
- 2.6.3.3 Make proper use of trim control
- 2.6.3.4 Scan continuously without fixation or omission
- 2.6.3.5 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting
- flaps setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.7 Precision descent

Learning Objectives

Precision descent requires descent at a specific rate and airspeed and so an analysis of this task is a combination of those two activities (see tasks 2.5 and 2.6). This rate is usually 500fpm, speed approximately 70kts. Flaps are usually used.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting
- flaps setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., and altitude within 100 ft.. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.8 Level turns

Learning Objectives

2.8.1 Maintain straight-and-level flight

2.8.2 Transition from straight-and-level flight to level turning flight
- 2.8.2.1 Apply coordinated aileron and rudder pressures in desired direction of turn
- 2.8.2.2 Roll into turn at a rate based on rate of instrument cross-check and interpretation (Nothing is gained by maneuvering an airplane faster than your capacity to keep up with changes in instrument indications)
- 2.8.2.3 Use attitude indicator to establish approximate angle of bank needed (approximately 15 degrees)
- 2.8.2.4 Use altimeter, vertical speed indicator, and attitude indicator for pitch adjustments necessary as vertical lift component decreases with increase in bank
- 2.8.2.5 Use airspeed indicator to maintain constant airspeed
- 2.8.2.6 Scan continuously without fixation or omission

2.8.3 Maintain turn
- 2.8.3.1 Use attitude indicator as primary bank instrument
- 2.8.3.2 Use turn coordinator as secondary bank instrument and primary for controlling yaw (step on the ball)
- 2.8.3.3 Make proper use of trim control
- 2.8.3.4 Scan continuously without fixation or omission
- 2.8.3.5 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

2.8.4 Transition from turning to straight-and-level flight at desired heading
- 2.8.4.1 Roll out of turn beginning at a point before desired heading approximately equal to half your angle of bank
- 2.8.4.2 Apply coordinated aileron and rudder pressures opposite direction of turn
- 2.8.4.3 Roll out of turn at same rate as was used to roll in to turn

2.8.4.4 Use heading indicator as primary bank instrument when airplane is approximately level, as in straight-and-level flight
2.8.4.5 Scan continuously without fixation or omission
2.8.4.6 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

2.8.5 Maintain straight-and-level flight

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes.

Device Qualification Guidelines
Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.9 Standard rate turn

Learning Objectives

2.9.1 Maintain straight-and-level flight

2.9.2 Transition from straight-and-level flight to level standard rate turn
2.9.2.1 Apply coordinated aileron and rudder pressures in desired direction of turn
2.9.2.2 Roll into turn at a rate based on rate of instrument cross-check and interpretation

2.9.2.3 Establish approximate angle of bank needed for a standard rate turn (dependent on airspeed, use TAS/10 + 5 for approximate angle of bank) using attitude indicator, then check miniature aircraft of turn coordinator for a standard rate turn indication

2.9.2.4 Make pitch adjustments necessary as vertical lift component decreases with increase in bank using altimeter, vertical speed indicator, and attitude indicator

2.9.2.5 Maintain constant airspeed using airspeed indicator

2.9.2.6 Scan continuously without fixation or omission

2.9.3 Maintain turn

2.9.3.1 Use turn coordinator as primary bank instrument and attitude indicator as supporting bank instrument

2.9.3.2 Control yaw using ball of turn coordinator

2.9.3.3 Make proper use of trim control

2.9.3.4 Scan continuously without fixation or omission

2.9.3.5 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

2.9.4 Transition from turning to straight-and-level flight at desired heading

2.9.4.1 Begin rolling out of turn at a point before reaching desired heading approximately equal to half your angle of bank

2.9.4.2 Apply coordinated aileron and rudder pressures opposite direction of turn

2.9.4.3 Roll out of turn at same rate as was used to roll in to turn

2.9.4.4 Initiate turn recovery using attitude indicator as primary bank instrument

2.9.4.5 Use heading indicator as primary bank instrument when airplane is approximately level, as in straight-and-level flight

2.9.4.6 Scan continuously without fixation or omission

2.9.4.7 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

2.9.5 Maintain straight-and-level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.10 Short turns

Learning Objectives

Short turns are defined here as turns requiring a change in heading of less than 15 degrees. The task requirements for short turns are the same as those for level turns (see Task 2.8) with the exception that the bank angle established is approximately equal to the required change in heading (e.g., a turn from 240 degrees to 250 degrees would require a bank angle of approximately 10 degrees while a turn from 240 degrees to 245 degrees would require a bank angle of approximately 5 degrees)

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.11 Climbing turn

Learning Objectives

Climbing turns combine the techniques used in straight climbs with the various turn techniques (see Tasks 2.3, 2.4, 2.8-2.10). The aerodynamic factors affecting lift and power control must be considered in determining power settings, and the rate of cross-check and interpretation must be increased to enable control of bank as well as pitch changes.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, and from one altitude to another, feedback should be provided both in maintaining the initial heading and altitude, and in achieving and maintaining the second heading and altitude. The trainee should receive practice at turning both left and right through various degrees of heading and altitude changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.12 Descending turn

Learning Objectives

Descending turns combine the techniques used in straight descents with the various turn techniques (see Tasks 2.5, 2.6, 2.8-2.10). The aerodynamic factors affecting lift and power control must be considered in determining power settings, and the rate of cross-check and interpretation must be increased to enable control of bank as well as pitch changes.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, and from one altitude to another, feedback should be provided both in maintaining the initial heading and altitude, and in achieving and maintaining the second heading and altitude. The trainee should receive practice at turning both left and right through various degrees of heading and altitude changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Authorization: Instrument Rating
Task Set: 2.0 Flight by Reference to Instruments
Task: 2.13 Steep turns

Learning Objectives

2.13.1 Maintain straight-and-level flight

2.13.2 Transition from straight-and-level flight to level steep turn
  2.13.2.1 Add power (usually to around 2400 RPM)
  2.13.2.2 Apply coordinated aileron and rudder pressures in desired direction of turn

2.13.2.3 Roll into turn at a rate based on rate of instrument cross-check and interpretation (Nothing is gained by maneuvering an airplane faster than your capacity to keep up with changes in instrument indications)
2.13.2.4 Use attitude indicator to establish approximate angle of bank needed (approximately 45 degrees)
2.13.2.5 After bank angle exceeds 30 degrees, begin putting back pressure on column to compensate for loss of vertical lift component
2.13.2.6 Use altimeter, vertical speed indicator, and attitude indicator for pitch adjustments necessary as vertical lift component decreases with increase in bank
2.13.2.7 Use airspeed indicator to maintain constant airspeed
2.13.2.8 Scan continuously without fixation or omission

2.13.3 Maintain turn
2.13.3.1 Use attitude indicator as primary bank instrument
2.13.3.2 Use turn coordinator as secondary bank instrument and primary for controlling yaw (step on ball)
2.13.3.3 Scan continuously without fixation or omission
2.13.3.4 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

2.13.4 Transition from turning to straight-and-level flight at desired heading
2.13.4.1 Begin rolling out of turn at a point before reaching desired heading approximately equal to half your angle of bank
2.13.4.2 Apply coordinated aileron and rudder pressures opposite direction of turn
2.13.4.3 Roll out of turn at same rate as was used to roll in to turn
2.13.4.4 Use heading indicator as primary bank instrument when approximately level as in straight-and-level flight
2.13.4.5 Scan continuously without fixation or omission
2.13.4.6 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

2.13.5 Maintain straight-and-level flight

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. Steep turns are usually 180° or 360° to the left or right and both left and right turns should be practiced.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Table 4. Instrument Flying Task Analysis: Abnormal and Emergency Procedures

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.1 Recovery from unusual attitudes

Learning Objectives

3.1.1 Recognize unusual attitude
- 3.1.1.1 Note an instrument rate of movement or indication other than those associated with basic instrument flight maneuvers
- 3.1.1.2 Increase speed of scan
- 3.1.1.3 Distinguish between unusual attitude, instrument error, or instrument malfunction

3.1.2 Initiate recovery by reference to airspeed indicator, altimeter, vertical-speed indicator, and turn coordinator (not attitude indicator)

3.1.3 Recover from a nose-high attitude
- 3.1.3.1 Increase power as necessary in proportion to observed deceleration
- 3.1.3.2 Apply forward elevator pressure to lower nose and prevent a stall
- 3.1.3.3 Correct bank by applying coordinated aileron and rudder pressure to level miniature aircraft and center ball of turn coordinator
- 3.1.3.4 Apply corrective control applications almost simultaneously but in sequence given above

3.1.4 Recover from a nose-low attitude
- 3.1.4.1 Reduce power to prevent excessive airspeed and loss of altitude if airspeed is increasing, or is above desired airspeed
- 3.1.4.2 Correct bank attitude with coordinated aileron and rudder pressure to straight flight by referring to turn coordinator
- 3.1.4.3 Raise nose to level flight attitude by smooth back elevator pressure
- 3.1.4.4 Apply corrective control applications almost simultaneously but in sequence given above

3.1.5 Confirm recovery by reference to level miniature aircraft and centered ball of turn coordinator

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, at a pitch angle greater than ±25°, and a bank angle greater than ±40°, with an airspeed dependent on attitude but greater than stall and less than VA. The system should provide feedback regarding following the appropriate sequence of actions required to return to straight-and-level flight. Recovery from unusual attitudes should be practiced from both nose high and nose low positions and banked both left and right.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Instructional Management:

Independent of the simulation, user is able to manipulate aircraft attitude
User receives feedback regarding whether pitch, bank, and power corrections are made in an appropriate sequence to return aircraft to straight-and-level flight.

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.2 Timed turns

Learning Objectives

3.2.1 Calibrate turn coordinator
3.2.1.1 Establish a standard rate turn as indicated by turn coordinator and as sweep second hand of clock passes a cardinal point (12, 3, 6, 9), or start timer
3.2.1.2 Note heading on heading indicator
3.2.1.3 While holding indicated rate of turn constant, note indicated heading changes at 10-second intervals
3.2.1.4 Note whether a larger or smaller deflection of miniature aircraft of turn coordinator is necessary to produce a standard rate turn

3.2.2 Maintain straight-and-level flight

3.2.3 Compute required turn interval to achieve desired heading

3.2.4 Transition from straight-and-level flight to level standard rate turn
3.2.4.1 Apply coordinated aileron and rudder pressures in desired direction of turn

3.2.4.2 Roll into turn at a rate based on rate of instrument cross-check and interpretation
3.2.4.3 Use miniature aircraft of turn coordinator to establish angle of bank needed for a standard rate turn
3.2.4.4 Use altimeter and vertical speed indicator for pitch adjustments necessary as vertical lift component decreases with increase in bank
3.2.4.5 Use airspeed indicator to maintain constant airspeed
3.2.4.6 Scan continuously without fixation or omission

3.2.5 Maintain turn
3.2.5.1 Use turn coordinator as primary bank instrument, altimeter as primary for pitch control, and airspeed indicator for power control
3.2.5.2 Use ball of turn coordinator to control yaw
3.2.5.3 Substitute clock in place of heading indicator within your scan pattern
3.2.5.4 Make proper use of trim control
3.2.5.5 Scan continuously without fixation or omission
3.2.5.6 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

3.2.6 Transition from turning to straight-and-level flight at desired heading
3.2.6.1 Begin rolling out of turn after required amount of time has elapsed
3.2.6.2 Apply coordinated aileron and rudder pressures opposite direction of turn
3.2.6.3 Roll out of turn at same rate as was used to roll in to turn
3.2.6.4 Scan continuously without fixation or omission
3.2.6.5 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

3.2.7 Maintain straight-and-level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- elapsed time from a chosen point

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- start, stop and reset timer (unless a continuously running clock is used)

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided in maintaining the initial heading and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes. During practice at this task, the attitude and heading indicators should be nonfunctional or blanked out.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Instructional Management:
Attitude and heading indicators can be rendered nonfunctional or blanked out.

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.3 Compass turns

Learning Objectives

Bear in mind the following points when making turns to magnetic compass headings or when using the magnetic compass as a reference for setting the heading indicator.

3.3.1 If you are on a northerly heading and you start a turn to the east or west, indication of compass lags, or shows a turn in opposite direction

3.3.2 If you are on a southerly heading and you start a turn to the east or west, compass indication precedes turn, showing a greater amount of turn than is actually occurring

3.3.3 As you accelerate airplane, compass indicates a turn to north

3.3.4 As you decelerate airplane, compass indicates a turn to south

3.3.5 Amount of lag or lead in a turn to a northerly or southerly heading is approximately equal to latitude of aircraft

3.3.6 Abrupt changes in attitude or airspeed make accurate interpretations of compass difficult. Proficiency in compass turns depends on knowledge of compass characteristics, smooth control technique, and accurate bank and pitch control

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided in maintaining the initial heading and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes. During practice at this task, the attitude and heading indicators should be nonfunctional or blanked out.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Instructional Management:
Attitude and heading indicators can be rendered nonfunctional or blanked out

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Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.4 Partial panel maneuvers

Learning Objectives

Partial panel maneuvers are performed in the same manner as full panel maneuvers with the exception that the attitude and heading indicators are not included in the visual scan. The following points should be kept in mind while performing partial panel maneuvers:

3.4.1 Use turn coordinator as primary bank instrument and magnetic compass as secondary bank instrument

3.4.2 Use airspeed indicator, altimeter, and vertical speed indicator to monitor pitch

3.4.3 Use a consistent power setting for each desired configuration. By setting power and holding altitude, you will automatically configure correct attitude and airspeed

3.4.4 Always trim aircraft after it has been stabilized to avoid unusual attitudes

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. In addition, since the trainee is transitioning from one heading to another, feedback should be provided in maintaining the initial heading and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes. During practice at this task, the attitude and heading indicators should be nonfunctional or blanked out.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Instructional Management:
Attitude and heading indicators can be rendered nonfunctional or blanked out

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Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.5 Loss of communications

Learning Objectives
3.5.1 Squawk 7700 on transponder

3.5.2 Comply with the procedures outlined in FAR 91.185

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- communications radio status
- transponder status

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- transponder setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. The trainee should receive some indication from the system that the radio is not functioning.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical or virtual controls for setting a transponder code

Displays:

Transponder display

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.6 Instrument failure

Learning Objectives

3.6.1 Recognize instrument failure

3.6.2 Alter scan pattern to compensate for failed instrument

3.6.3 Increase speed of scan to compensate for failed instrument

3.6.4 Fly airplane

3.6.5 Report failure to ATC if malfunction is a loss of VOR, TACAN, or ADF receiver, complete or partial loss of ILS receiver capability, or impairment of air/ground communications capability

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. The instructor should have the ability to disable, turn off, or blank out any one or more of the instruments prior to beginning a training session and to disable or turn off any one or more of the instruments during the training session. In addition, to gain proficiency in recognizing instrument failure, it would be useful for the system to be capable of randomly failing an instrument within a specified period of time or during the performance of a particular maneuver.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Instructional Management:
Instructor can disable, turn off, or blank out any one or more of the instruments prior to the beginning of a training session, and fail, or turn off any one or more of the instruments during a training session.

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.7 Systems failure

Learning Objectives

3.7.1 Recognize systems failure (electrical, vacuum, etc.)

3.7.2 Alter scan to compensate for failed instruments

3.7.3 Increase speed of scan

3.7.4 Fly airplane

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- system failure indications

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft. The instructor should have the ability to disable any one of the aircraft systems during the training session. In addition, to gain proficiency in recognizing a system failure, it would be useful for the device to be capable of randomly failing a system within a specified period of time or during the performance of a particular maneuver.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Displays:
Displays indicating a system failure including:
alternator light
low suction warning light

Instructional Management:
Instructor can disable any one of the aircraft systems during the training session

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Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.8 Turbulence

Learning Objectives

The presence of turbulence does not change the task requirements of any of the flight tasks but makes them more difficult to perform. Pilots must compensate for the presence of turbulence by increasing their rate of scan and making more adjustments to maintain proper control of the aircraft.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. The instructor should have the ability to control the amount of turbulence encountered during the performance of the task both before the session begins and during the session.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of turbulence are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of turbulence encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.9 Engine failure

Learning Objectives

3.9.1 Recognize engine failure

3.9.2 Configure aircraft for maximum glide
- 3.9.2.1 Set flaps up
- 3.9.2.2 Place wings level
- 3.9.2.3 Place nose down to appropriate attitude

3.9.3 Perform engine failure checklist
- 3.9.3.1 Set mixture rich
- 3.9.3.2 Turn on carburetor heat
- 3.9.3.3 Check magneto switch set on "BOTH"
- 3.9.3.4 Check fuel quantity

3.9.4 Restart engine

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- engine status (working/not working)
- carburetor heat setting
- magneto switch setting
- fuel quantity
- fuel mixture setting

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- carburetor heat setting
- magneto switch setting
- fuel mixture setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. The instructor should have the ability to cause the system to simulate an engine failure during the course of a task.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical or virtual controls for carburetor heat, magneto switch and fuel mixture.

Displays:
Display showing status of carburetor heat, magneto switch, fuel mixture, and fuel quantity.

Flight Dynamics:
The handling and performance qualities of the simulated aircraft during simulated engine failure are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the presence of an engine failure during a training session.

Authorization: Instrument Rating
Task Set: 3.0 Abnormal and Emergency Procedures
Task: 3.10 Lost procedures

Learning Objectives

The primary part of this task would involve communication with Air Traffic Control (Task Set 6.0). In addition, interpretation of navigational charts would come into play. However, the use of such charts would have to be accomplished while maintaining positive control of the aircraft and so an important aspect of this task is learning how to perform multiple activities simultaneously without compromising safety.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- fuel quantity
- navigational chart information

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5° and altitude within 100 ft.. Navigational charts should be available for the navigational database area available on the PCATD. The simulation of ATC communication can be done by the instructor using a separate display showing the trainees position within the navigational area.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical control for radio microphone

Instructional Management:
Instructor has a separate display showing the location of the trainee within the navigational area available on the PCATD

Table 5. Instrument Flying Task Analysis: Radio Navigation Procedures

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.1 VOR Navigation

Learning Objectives

4.1.1 Tune VOR receiver
- 4.1.1.1 Select frequency of VOR station
- 4.1.1.2 Identify correct station received
- 4.1.1.3 Adjust volume of VOR receiver to comfortable level
- 4.1.1.4 Note change in VOR display from "OFF" to "TO" or "FROM"
- 4.1.1.5 Rotate omni-bearing selector (OBS) until course deviation indicator (CDI) centers (with "TO" rotate OBS toward deflection of CDI, with "FROM" rotate OBS away from deflection of CDI)

4.1.2 Orient to VOR
- 4.1.2.1 Note whether VOR flag is "TO" or "FROM"
- 4.1.2.2 Note course at which CDI is centered
- 4.1.2.3 Determine position of aircraft relative to VOR station

4.1.3 Intercept VOR radial
- 4.1.3.1 Turn to a heading parallel to desired course, in same direction as course to be flown
- 4.1.3.2 Determine difference between radial to be intercepted and current radial
- 4.1.3.3 Determine interception angle to desired radial (double difference between current radial and desired radial, not less than 20° or greater than 90°
- 4.1.3.4 Rotate OBS to desired radial
- 4.1.3.5 Turn to interception heading
- 4.1.3.6 Hold heading until CDI centers, leading turn to prevent overshooting the course
- 4.1.3.7 Turn to desired heading

4.1.4 Track VOR radial
- 4.1.4.1 Maintain desired heading using CDI needle
- 4.1.4.2 Observe CDI for deflection left or right
- 4.1.4.3 Turn 20° toward needle and hold heading until needle centers to correct for crosswind
- 4.1.4.4 Reduce crosswind correction to 10° and note whether drift-correction angle keeps CDI centered
- 4.1.4.5 Make further corrections for crosswind as necessary using smaller correction changes until the CDI remains centered

4.1.5 Recognize VOR station passage by noting change from "TO" to "FROM" flag

4.1.6 Track VOR radial outbound in same manner as inbound tracking is accomplished

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 5°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and CDI within a three-quarter-scale deflection. The task should begin with the aircraft positioned at varying locations relative to the VOR station to provide practice at determining aircraft position and intercepting and tracking a VOR radial. Amount of crosswind should be varied from none to at least 10 kts.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller

Instructional Management:

Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.2 NDB Navigation

Learning Objectives

4.2.1 Tune ADF receiver
- 4.2.1.1 Select frequency of NDB station
- 4.2.1.2 Identify correct station received
- 4.2.1.3 Adjust volume of ADF receiver to comfortable level

4.2.2 Orient to NDB
- 4.2.2.1 Note relative bearing to station indicated on ADF
- 4.2.2.2 Note current heading on heading indicator
- 4.2.2.3 Determine bearing to station (Current heading plus relative bearing)

4.2.3 Track NDB radial
- 4.2.3.1 Turn to heading that will zero ADF needle
- 4.2.3.2 Note deflection of ADF needle to left or right
- 4.2.3.3 Turn in direction of needle deflection when change in azimuth of 2° to 5° has occurred (magnitude of turn depends on observed rate of bearing change, true airspeed, and desired time to return to course)
- 4.2.3.4 Maintain interception angle until needle deflection from zero almost equals angle of interception (amount of lead depends on distance from station, rate of closure, number of degrees to be turned, and rate of turn)
- 4.2.3.5 Turn to establish heading opposite direction of original needle deflection an amount equal to drift correction angle
- 4.2.3.6 Modify heading to compensate for further deflection of ADF needle

4.2.4 Recognize NDB station passage by noting steady rotation of ADF needle toward wing-tip position or erratic left/right oscillations

4.2.5 Track NDB radial outbound in same manner as inbound tracking is accomplished except interception angle causes needle deflection away from 180° position

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- NDB station frequency and bearing

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- NDB station frequency

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 5°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and bearing to station within 10°. The task should begin with the aircraft positioned at varying locations relative to the NDB station to provide practice at determining aircraft position and intercepting and tracking an NDB radial. Amount of crosswind should be varied from none to at least 10 kts.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller

Instructional Management:

Feedback is presented by the system regarding maintaining the ADF within a specified range of deviation. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.3 Localizer and ILS Navigation

Learning Objectives

The mechanics of ILS navigation are essentially identical to those of VOR navigation (see task 4.1) with the exception that the ILS display is more sensitive (1 dot equals 2.5° instead of 10°) and includes a glide slope indication.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 5°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and CDI within a three-quarter-scale deflection. The task should begin with the aircraft positioned at varying locations relative to the VOR station to provide practice at determining aircraft position and intercepting and tracking a VOR radial. Amount of crosswind should be varied from none to at least 10 kts.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.4 DME Arc

Learning Objectives

4.4.1 Track inbound on current heading

4.4.2 Turn 90° left or right (depending on position from station) when .5 nm from arc
- 4.4.2.1 Monitor DME readout closely to gauge when to roll out of turn
- 4.4.2.2 Maintain continuous mental picture of position relative to station
- 4.4.2.3 Note ADF needle at wingtip position after completion of turn

4.4.3 Fly segment of arc
- 4.4.3.1 Maintain constant heading and altitude until ADF needle is 5° to 10° behind wingtip
- 4.4.3.2 Turn toward station until ADF needle is 5° to 10° ahead of wingtip
- 4.4.3.3 Correct for crosswind by adjusting amount that ADF needle is positioned ahead and behind wingtip

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- NDB station frequency and bearing
- distance from station

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- NDB station frequency

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, approximately 2nm from arc, inbound on a 90° bearing to the arc. The system should provide feedback regarding the maintenance of heading within 5°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., bearing to station within 10°, and distance from station within 1nm. The task should begin with the aircraft positioned at varying locations relative to the NDB station to provide practice at determining aircraft position and intercepting and tracking a DME arc. Amount of crosswind should be varied from none to at least 10 kts.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical or virtual control for DME receiver

Displays:
DME display

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the ADF within a specified range of deviation.
Feedback is presented by the system regarding maintaining the distance from the arc within a specified range of deviation.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.5 VOR Holding Pattern

Learning Objectives

4.5.1 Tune VOR receiver to station used to determine holding fix
- 4.5.1.1 Select frequency of VOR station
- 4.5.1.2 Identify correct station received
- 4.5.1.3 Adjust volume of VOR receiver to comfortable level
- 4.5.1.4 Note change in VOR display from "OFF" to "TO" or "FROM"
- 4.5.1.5 Rotate omni-bearing selector (OBS) to appropriate bearing for holding fix

4.5.2 Determine position relative to holding fix

4.5.3 Determine entry pattern to holding pattern (standard holding pattern)

4.5.3.1 Select a parallel entry pattern if position relative to holding fix is within an arc defined by extending a line inbound along the holding course and a line 110° from the holding course line in a clockwise direction, originating from the holding fix

4.5.3.2 Select a teardrop entry pattern if position relative to holding fix is within an arc defined by the holding course line and a line 70° from the holding course line in a counterclockwise direction, originating from the holding fix

4.5.3.3 Select a direct entry pattern if position relative to holding fix is within any other part of the circle not defined in paragraphs 4.5.3.1 and 4.5.3.2 above

4.5.4 Reduce airspeed from cruising speed to holding speed

4.5.5 Note passage of holding fix

4.5.6 Perform appropriate pattern entry

4.5.6.1 Fly a parallel entry pattern by turning to a heading opposite but parallel holding course, then performing a level left turn to return to holding fix or intercept holding course

4.5.6.2 Fly a teardrop entry pattern by turning to an outbound track of 30° or less to holding course, then performing a level right turn to intercept holding course

4.5.6.3 Fly a direct entry pattern by turning to the inbound heading and then immediately executing a right hand procedure turn to begin holding pattern

4.5.7 Fly holding pattern

4.5.7.1 Fly inbound on holding course until passage of holding fix

4.5.7.2 Execute 180° right turn

4.5.7.3 Fly outbound for 1 minute

4.5.7.4 Execute 180° right turn

4.5.7.5 Fly inbound on holding course until passage of holding fix

4.5.8 Adjust pattern for wind

4.5.9 Time pattern exit

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- holding instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at least 3.5 minutes from the holding fix in order to allow time to transition from cruise to the holding airspeed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and CDI within a three-quarter-scale deflection. This procedure should be practiced beginning from several different directions from the holding fix to give the trainee practice at orienting to the fix and deciding how to enter the holding pattern. Amount of crosswind should be varied from none to at least 10 kts. Specific holding instructions can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller

Instructional Management:
Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.6 NDB Holding Pattern

Learning Objectives

A NDB holding pattern is essentially the same as a VOR holding pattern with the exception that determination of the holding fix and position to the holding fix is accomplished using the ADF receiver and not a VOR.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- NDB station frequency and bearing
- holding instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- NDB station frequency

Training Considerations
The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at least 3.5 minutes from the holding fix in order to allow time to transition from cruise to the holding airspeed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and bearing to station within 10°. This procedure should be practiced beginning from several different directions from the holding fix to give the trainee practice at orienting to the fix and deciding how to enter the holding pattern. Amount of crosswind should be varied from none to at least 10 kts. Specific holding instructions can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the bearing to the station within a specified range of deviation.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.7 Localizer Holding Pattern

Learning Objectives

A localizer holding pattern is essentially the same as a VOR procedure with the exception that determination of the holding fix and position to the holding fix is accomplished using either an ADF receiver or a VOR, depending on the facilities available at the airport in question. Also, a LOM could be used to determine arrival at the holding fix.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing or NDB station frequency and bearing
- holding instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency or NDB station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at least 3.5 minutes from the holding fix in order to allow time to transition from cruise to the holding airspeed. Either an ADF, LOM, or a VOR will be used to determine arrival at the holding fix. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and CDI within a three-quarter-scale deflection or ADF bearing within 10°. This procedure should be practiced beginning from several different directions from the holding fix to give the trainee practice at orienting to the fix and deciding how to enter the holding pattern. Amount of crosswind should be varied from none to at least 10 kts. Specific holding instructions can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection. Feedback is presented by the system regarding maintaining ADF bearing within a specified range of deviation. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.8 DME Holding Pattern

Learning Objectives

A DME holding pattern is essentially the same as a VOR procedure with the exception that determination of the holding fix and position to the holding fix is accomplished using DME arc procedures (Task 4.4).

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing or NDB station frequency and bearing
- distance to reference station
- holding instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency or NDB station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. Either an ADF or a VOR will be used to determine arrival at the holding fix. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., CDI within a three-quarter-scale deflection or ADF bearing within 10°, and distance to the arc within 1nm. This procedure should be practiced beginning from several positions along a DME arc. Amount of crosswind should be varied from none to at least 10 kts. Specific holding instructions can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical or virtual control for DME receiver

Displays:
DME display

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.
Feedback is presented by the system regarding maintaining ADF bearing within a specified range of deviation.
Feedback is presented by the system regarding maintaining the distance from the arc within a specified range of deviation.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Instrument Rating
Task Set: 4.0 Radio Navigation Procedures
Task: 4.9 Intersection Holding Pattern

Learning Objectives

An intersection holding pattern is essentially the same as a VOR procedure with the exception that determination of the holding fix requires the use of two VORs (usually) or a VOR and an ADF.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- NDB station frequency and bearing
- holding instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- NDB station frequency
- course deviation indicator setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at least 3.5 minutes from the holding fix in order to allow time to transition from cruise to the holding airspeed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., CDI within a three-quarter-scale deflection, and ADF bearing within 10°. This procedure should be practiced beginning from several different directions from the holding fix to give the trainee practice at orienting to the fix and deciding how to enter the holding pattern. Amount of crosswind should be varied from none to at least 10 kts. Specific holding instructions can be provided by the instructor. This task can be accomplished using two VORs or one VOR and one ADF.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.
Feedback is presented by the system regarding maintaining the ADF bearing within a specified range of deviation.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Table 6. Instrument Flying Task Analysis: Instrument Approaches

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.1 VOR/VORTAC instrument approach procedure

Learning Objectives

5.1.1 Initial approach segment

5.1.1.1 Take out appropriate approach plate
5.1.1.2 Find primary and secondary VORs (if present) on approach plate
5.1.1.3 Set primary VOR frequency on NAV1 and ident
5.1.1.4 Set secondary VOR frequency on NAV2 and ident
5.1.1.5 Select final approach heading on OBS1
5.1.1.6 Select heading from secondary VOR on OBS2 for identification of FAF
5.1.1.7 From approach plate, note missed approach procedure and MDA
5.1.1.8 Maintain straight-and-level flight
5.1.1.9 Reset heading indicator to magnetic compass reading
5.1.1.10 Turn to headings under direction of ATC. Typical ATC instruction is as follows "Turn left heading 210°, maintain 3800 until established on final approach course, cleared for VOR 17L approach at Will Rogers."
5.1.1.11 Readback ATC instructions
5.1.1.12 Monitor course direction indicator (CDI) to primary VOR
5.1.1.13 As CDI centers, turn to final approach heading and track radial inbound

5.1.2 Intermediate approach segment

5.1.2.1 Continue to track radial inbound
5.1.2.2 Reduce speed 10% to 20% while descending to appropriate segment altitude indicated on approach plate at approximately 500 FPM
5.1.2.3 Begin level off at appropriate point prior to reaching desired altitude
5.1.2.4 Maintain straight-and-level flight until you reach final approach fix

5.1.3 Final approach segment

5.1.3.1 Communicate to tower that FAF has been passed, for example, "Cessna 918, passing Kongg".
5.1.3.2 Start timer (in order to identify missed approach point, unless DME equipment is available or FAF is positioned at the runway).
5.1.3.3 Begin descent to appropriate segment altitude at 500-700fpm.
5.1.3.4 Select bearing on OBS2 for identification of next intersection (if applicable)
5.1.3.5 Select first stage flaps (depending on aircraft, not in a Cessna 172)
5.1.3.6 Continue to track radial inbound
5.1.3.7 Monitor secondary CDI to identify final intersection passage
5.1.3.8 Level off until past final intersection
5.1.3.9 Begin descent to MDA at 500-700fpm
5.1.3.10 Level off at MDA
5.1.3.11 At missed approach point make decision to perform a missed approach or to land.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- NDB station frequency and bearing
- instrument approach procedure plates
- time elapsed from specific points
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- NDB station frequency
- course deviation indicator setting
- timer or clock setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position 5 minutes prior to beginning the intermediate approach segment to allow time to secure approach chart, set up navigational frequencies, reset heading indicator to magnetic compass, and review approach procedure. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., CDI within a full-scale deflection prior to the final approach segment and a three-quarter-scale deflection during final approach, and ADF bearing within 10°. During final approach, the system should provide feedback regarding maintaining altitude within 100 ft., but not below the minimum descent altitude until reaching the missed approach point. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. Although the example used two VORs, this task can be accomplished using one VOR and one ADF. Finally, it is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical communications radio microphone

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.

Feedback is presented by the system regarding maintaining the ADF bearing within a specified range of deviation.
Feedback is presented by the system regarding maintaining altitude within 100 ft., but not below the minimum descent altitude.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
PCATD has a navigational area data base that is local to the training facility.

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.2 NDB instrument approach procedure

Learning Objectives

The NDB instrument approach procedure is essentially similar to a VOR approach procedure (Task 5.1) with the exception that the ADF is used to identify the final approach fix (FAF) and all approach headings are determined using the ADF card.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- NDB station frequency and bearing
- instrument approach procedure plates
- time elapsed from specific points
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- NDB station frequency
- timer or clock setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position 5 minutes prior to beginning the intermediate approach segment to allow time to secure approach chart, set up navigational frequencies, reset heading indicator to magnetic compass, and review approach procedure. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., and ADF bearing within 10°. During final approach, the system should provide feedback regarding maintaining altitude within 100 ft., but not below the minimum descent altitude until reaching the missed approach point. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. Finally, it is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Feedback is presented by the system regarding maintaining the ADF bearing within a specified range of deviation.
Feedback is presented by the system regarding maintaining altitude within 100 ft., but not below the minimum descent altitude.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
PCATD has a navigational area data base that is local to the training facility.

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.3 ILS/MLS instrument approach procedure

Learning Objectives

The ILS/MLS instrument approach procedure is essentially similar to a VOR approach procedure (Task 5.1) with the exception that an instrument landing system (ILS) is used to orient to the runway. The ILS consists of the following components: 1) Localizer radio course to furnish horizontal guidance to airport runway; 2) Glide slope radio course for vertical guidance along correct descent angle to proper "touchdown" point on the runway; 3) Two VHF marker beacons (outer and middle) to provide radio fixes along approach path to runway (some locations use a third marker beacon to indicate decision height point on a Category II ILS); and 4) Approach lights to provide a means for transition from instrument to visual flight. In addition the following elements may be included to increase system safety and utility: 1) Compass locators to provide transition from enroute NAVAIDS to the ILS system, assist in holding procedures, track localizer course, identify marker beacon sights, and provide a final approach fix for ADF approaches; 2) Distance measuring equipment; and 3) Supplementary lighting systems. For a localizer approach, however, the only required navigation equipment is a localizer receiver and a marker beacon receiver.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- NDB station frequency and bearing
- instrument approach procedure plates
- time elapsed from specific points
- radio communications from ATC
- LOM signal
- glide slope deviation

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- NDB station frequency
- course deviation indicator setting
- timer or clock setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position 5 minutes prior to beginning the intermediate approach segment to allow time to secure approach chart, set up navigational frequencies, reset heading indicator to magnetic compass, and review approach procedure. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., localizer and glide slope indications within a three-quarter-scale deflection during final approach, and ADF bearing within 10°. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. It is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical communications radio microphone

Displays:

LOM receiver

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Feedback is presented by the system regarding maintaining the localizer and glide slope indicators within a specified range of deflection.

Feedback is presented by the system regarding maintaining altitude above the decision height before initiating a missed approach procedure or transitioning to a normal landing approach.

Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

PCATD has a navigational area data base that is local to the training facility.

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.4 ILS back course approach procedure

Learning Objectives

The ILS back course approach procedure is essentially similar to the ILS approach procedure (Task 5.3) with the exception that the CDI indications are reversed unless an HSI is being used.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- NDB station frequency and bearing
- instrument approach procedure plates
- time elapsed from specific points
- radio communications from ATC
- LOM signal
- glide slope deviation

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- NDB station frequency
- course deviation indicator setting
- timer or clock setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position 5 minutes prior to beginning the intermediate approach segment to allow time to secure approach chart, set up navigational frequencies, reset heading indicator to magnetic compass, and review approach procedure. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., localizer and glide slope indications within a three-quarter-scale deflection during final approach, and ADF bearing within 10°. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. It is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Displays:
LOM receiver

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Feedback is presented by the system regarding maintaining the localizer and glide slope indicators within a specified range of deflection.
Feedback is presented by the system regarding maintaining altitude above the decision height before initiating a missed approach procedure or transitioning to a normal landing approach.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
PCATD has a navigational area data base that is local to the training facility.

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.5 RNAV instrument approach procedure

Learning Objectives

The RNAV instrument approach procedure is essentially similar to a VOR approach procedure (Task 5.1) but requires the presence of an RNAV receiver. The receiver, when properly tuned and adjusted, will electronically displace a VOR to any given location. After the displacement, the approach proceeds just like a normal VOR approach.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- VOR station frequency and bearing
- NDB station frequency and bearing
- instrument approach procedure plates
- time elapsed from specific points
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- NDB station frequency
- course deviation indicator setting
- RNAV settings
- timer or clock setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position 5 minutes prior to beginning the intermediate approach segment to allow time to secure approach chart, set up navigational frequencies, reset heading indicator to magnetic compass, and review approach procedure. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft., CDI within a full-scale deflection prior to the final approach segment and a three-quarter-scale deflection during final approach, and ADF bearing within 10°. During final approach, the system should provide feedback regarding maintaining altitude within 100 ft., but not below the minimum descent altitude until reaching the missed approach point. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. It is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical communications radio microphone
Physical or virtual control for RNAV

Displays:

RNAV display

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.
Feedback is presented by the system regarding maintaining the ADF bearing within a specified range of deviation.
Feedback is presented by the system regarding maintaining altitude within 100 ft., but not below the minimum descent altitude.
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
PCATD has a navigational area data base that is local to the training facility.

Authorization: Instrument Rating
Task Set: 5.0 Instrument Approaches
Task: 5.6 Missed approach procedure

Learning Objectives

A missed approach will be initiated at the point where the aircraft has descended to authorized landing minimums at a specified distance from the runway if visual contact is not established, or if the landing has not been accomplished, or when directed by Air Traffic Control.

5.6.1 Decide to initiate missed approach procedure

5.6.2 Change aircraft configuration for climbing
- 5.6.2.1 Set throttle to full power
- 5.6.2.2 Set flaps to full up position
- 5.6.2.3 Turn carburetor heat off (if applicable)

5.6.3 Climb to altitude given on approach chart

5.6.4 Turn to heading given on approach chart

5.6.5 Contact ATC and advise missed approach

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed, at a position just prior to the missed approach point. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. Amount of crosswind should be varied from none to at least 10 kts. ATC communications can be provided by the instructor. It is required that at least some of the approaches practiced are local to the training area, which requires that the PCATD have a local navigational data base.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
PCATD has a navigational area data base that is local to the training facility.

Table 7. Instrument Flying Task Analysis: Communications Procedures

Authorization: Instrument Rating
Task Set: 6.0 Communications Procedures
Task: 6.1 Air Traffic Control Clearance

Learning Objectives
6.1.1 Tune communication radio

6.1.2 Concentrate on instructions

6.1.3 Copy instructions fast enough to keep up with clearance delivery

6.1.4 Read back clearance

6.1.5 Respond to instructions

6.1.6 Be familiar with area

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations
Communication with ATC can be performed while engaged in almost any flight activity, but initial practice should probably be accomplished while stationary on the ground, using the PCATD as a training aid for part-task training. Later practice would incorporate the flight simulation capabilities of the PCATD for full-task training (i.e., while holding a particular heading, altitude, and speed). The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor.

Device Qualification Guidelines
Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Authorization: Instrument Rating
Task Set: 6.0 Communications Procedures
Task: 6.2 Departure Clearances

Learning Objectives

Objectives are the same as any involving radio communications (Task 6.1) but specific communications are relevant to departure procedures.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

Communication with ATC can be performed while engaged in almost any flight activity, but initial practice should probably be accomplished while stationary on the ground, using the PCATD as a training aid for part-task training. Later practice would incorporate the flight simulation capabilities of the PCATD for full-task training (i.e., while performing a departure procedure). The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Authorization: Instrument Rating
Task Set: 6.0 Communications Procedures
Task: 6.3 Enroute Clearances

Learning Objectives

Objectives are the same as any involving radio communications (Task 6.1) but specific communications are relevant to enroute procedures

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

Communication with ATC can be performed while engaged in almost any flight activity, but initial practice should probably be accomplished while stationary on the ground, using the PCATD as a training aid for part-task training. Later practice would incorporate the flight simulation capabilities of the PCATD for full-task training (i.e., while performing an enroute procedure). The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Authorization: Instrument Rating
Task Set: 6.0 Communications Procedures
Task: 6.4 Arrival Clearances

Learning Objectives

Objectives are the same as any involving radio communications (Task 6.1) but specific communications are relevant to arrival procedures

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

Communication with ATC can be performed while engaged in almost any flight activity, but initial practice should probably be accomplished while stationary on the ground, using the PCATD as a training aid for part-task training. Later practice would incorporate the flight simulation capabilities of the PCATD for full-task training (i.e., while performing an arrival procedure). The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:

Physical communications radio microphone

Table 8. Instrument Flying Task Analysis: Cross-country Procedures

Authorization: Instrument Rating
Task Set: 7.0 Cross-country Procedures
Task: 7.1 Departure Procedures

Learning Objectives

7.1.1 Perform standard instrument departure (SID)
- 7.1.1.1 Check and tune navigation receivers
- 7.1.1.2 Prepare to conduct navigation in the event of loss of communications with ATC
- 7.1.1.3 Read and interpret appropriate SID chart
- 7.1.1.4 Contact departure control immediately following takeoff
- 7.1.1.5 Listen to instructions and fly basic instrument maneuvers
- 7.1.1.6 Monitor instruments to ensure continuous orientation to specified route

7.1.2 Perform radar-vectored departure
- 7.1.2.1 Check and tune navigation receivers
- 7.1.2.2 Prepare to conduct navigation in the event of loss of communications with ATC
- 7.1.2.3 Contact depature control immediately following takeoff
- 7.1.2.4 Listen to instructions and fly basic instrument maneuvers
- 7.1.2.5 Monitor instruments to ensure continuous orientation to specified route

7.1.3 Perform non-standard instrument departure
- 7.1.3.1 Check and tune navigation receivers
- 7.1.3.2 Proceed on course via most direct route
- 7.1.3.3 Monitor instruments to ensure continuous orientation to selected route

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC
- standard instrument departure charts

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering in straight-and-level flight, and at a geographic point within the departure area acceptable for such maneuvers. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor. SID charts consistent with the area flown should be available.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Authorization: Instrument Rating
Task Set: 7.0 Cross-country Procedures
Task: 7.2 Enroute Procedures

Learning Objectives

7.2.1 Maintain heading and altitude as filed or as directed by ATC

7.2.2 Read and interpret navigation charts and conform to specified restrictions

7.2.3 Monitor appropriate frequency and, unless operating under radar control, furnish position reports over reporting points

7.2.4 Monitor flight instruments to ensure adherence to intended flight route

7.2.5 Report any of the following malfunctions to ATC: 1) Loss of VOR, TACAN, or ADF receiver capability; 2) Complete or partial loss of ILS receiver capability; 3) Impairment of air/ground communications capability

7.2.6 Report any of the following conditions to ATC, without request by the controller: 1) Time and altitude/flight level reaching a holding fix or point to which cleared (except when in "Radar Contact"); 2) When vacating any previously assigned altitude/flight level for a newly assigned altitude/flight level; 3) When leaving any assigned holding fix or point (exept when in "Radar Contact"); 4) When leaving final approach fix inbound on final approach (exept when in "Radar Contact"); 5) When approach has been missed; 6) A corrected estimate at any time it becomes apparent that an estimate as previously submitted is in error in excess of three minutes (exept when in "Radar Contact"); or 7) When an altitude change will be made if operating on a clearance specifying "VFR conditions-on-top"

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a point within the enroute area. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor. Navigational charts consistent with the area flown should be available.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Authorization: Instrument Rating
Task Set: 7.0 Cross-country Procedures
Task: 7.3 Arrival Procedures

Learning Objectives

7.3.1 Fly a standard terminal arrival route (STAR) if available
- 7.3.1.1 Read and interpret appropriate STAR information
- 7.3.1.2 Listen to instructions and fly basic instrument maneuvers
- 7.3.1.3 Monitor instruments to ensure continuous orientation to specified route

7.3.2 Listen and follow ATC arrival instructions

7.3.3 Fly appropriate approach procedure

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- radio communications from ATC
- standard terminal arrival route information

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a point within the arrival area. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts., bank within 5°, altitude within 100 ft.. ATC communications can be provided by the instructor. STAR charts consistent with the area flown should be available.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 4)

Controls:
Physical communications radio microphone

Additional Qualification Guidelines
In addition to the baseline qualification guidelines listed at the front of this document, the following guidelines were added.

Controls:

19. Physical or virtual control for altimeter setting and carburetor heat
20. Physical or virtual controls for setting a transponder code
21. Physical or virtual controls for carburetor heat, magneto switch and fuel mixture
22. Physical control for radio microphone
23. Physical or virtual control for DME receiver
24. Physical or virtual control for RNAV

Displays:

25. PCATD can display all of the various forms of weather-related information, as well as a navigational chart and information related to the airports displayed on that chart.
26. PCATD can display a flight log and a flight plan.
27. PCATD should have the following displays
    - engine instruments
    - suction gauge.
28. Transponder display
29. Display showing status of carburetor heat, magneto switch, fuel mixture, and fuel quantity
30. Displays indicating a system failure including:
    - alternator light
    - low suction warning light
31. DME display
32. LOM receiver
33. RNAV display

Flight Dynamics:

34. The presence and amount of turbulence are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

35. The handling and performance qualities of the simulated aircraft during simulated engine failure are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
36. The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

37. PCATD can train knowledge of weather through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of weather-related knowledge that are lacking. PCATD can train ability to analyze a specific route of flight and destination in relation to weather information through the use of multiple choice questions, fill-in-the-blanks, etc.
38. PCATD provides feedback regarding the selection of route segments and checkpoints, the computation of headings, distances, airspeed, wind data, groundspeed, time enroute, estimated time between check points, fuel required, weight and balance, and the correct procedure for completing and filing a flight plan.
39. PCATD trains knowledge of anti-icing/deicing systems and their operating characteristics through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking for all of the following systems: 1) airframe; 2) propellor/intake; 3) fuel system; and 4) pitot-static.
40. PCATD trains knowledge of flight instrument systems and their operating characteristics and navigation systems and their operating methods through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
41. Independent of the simulation, user is able to manipulate aircraft attitude.
42. User receives feedback regarding whether pitch, bank, and power corrections are made in an appropriate sequence to return aircraft to straight-and-level flight.
43. Attitude and heading indicators can be rendered nonfunctional or blanked out.
44. Instructor can disable or blank out any one or more of the instruments prior to the beginning of a training session, and fail any one of more of the instruments during a training session.
45. Instructor can disable any one of the aircraft systems during the training session.
46. Instructor can control the amount of turbulence encountered during the performance of the task both before the session begins and during the session.
47. Instructor can control the presence of an engine failure during a training session.
48. Instructor has a separate display showing the location of the trainee within the navigational area available on the PCATD.
49. Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.
50. Feedback is presented by the system regarding maintaining the ADF within a specified range of deviation.
51. Feedback is presented by the system regarding maintaining the distance from the arc within a specified range of deviation.
52. Feedback is presented by the system regarding maintaining altitude within 100 ft., but not below the minimum descent altitude.
53. Feedback is presented by the system regarding maintaining the localizer and glide slope indicators within a specified range of deflection.
54. Feedback is presented by the system regarding maintaining altitude above the decision height before initiating a missed approach procedure or transitioning to a normal landing approach.
55. Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
56. PCATD has a navigational area data base that is local to the training facility.

CONCLUSIONS

Summarizing the results of the task analysis, the tasks found in task sets 1.0, Ground Phase, and 3.0, Abnormal and Emergency Procedures, require unique guidelines that are not needed for any of the other tasks within or outside these task sets. The tasks in task set 2.0, Flight by Reference to Instruments, do not require any further guidelines than those provided in the baseline qualification guidelines list. The only extra guideline required in both task set 6.0, Communications Procedures, and 7.0, Cross-country Procedures, that is not a part of the baseline qualification guidelines list is the presence of a radio microphone control. The control would not be required to function, but would serve to provide a realistic sense of the process of communicating with air traffic control. As is mentioned for many of the tasks, the instructor could provide ATC communications either directly to the student or over a headset arrangement.

For task set 4.0, Radio Navigation Procedures, the inclusion of only a small set of requirements is necessary beyond those given in the baseline list. This set is as follows:

Controls:

- A physical or virtual control for a DME receiver (for tasks 4.4 and 4.8 only)

Displays:

- DME display (for tasks 4.4 and 4.8 only)

Flight Dynamics:

- The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propellor.

Instructional Management:

- Feedback is presented by the system regarding maintaining the CDI within a specified range of deflection.
- Feedback is presented by the system regarding maintaining the ADF within a specified range of deviation.
- Feedback is presented by the system regarding maintaining a specified distance from the arc (or a station) - (for tasks 4.4 and 4.8 only).
- The instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

For task set 5.0, Instrument Approaches, the extra requirements include the presence of a radio microphone control, an RNAV control (task 5.5 only), an LOM display (ILS tasks only), an RNAV display (task 5.5 only), wind equations and the ability to control wind parameters, feedback regarding maintaining CDI, ADF, localizer and glide slope indications, and altitude above minimum descent altitude, and the presence of a navigational data base that is local to the training facility.

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